Magnification

Worked solutions

GCSE science calculations

This topic online

1 Lena looks at a cheek cell with a light microscope and draws it. In her drawing the cell is 36 mm wide.

The real width of the cell is 0.06 mm.

Calculate the magnification of her drawing. (2 marks)

Magnification = size of image ÷ size of real object

magnification = 36 ÷ 0.06

magnification = 600

x600

2 A photograph in a revision guide shows a single onion skin cell. The cell is 45 mm long in the photograph.

The real cell is 0.15 mm long.

Calculate the magnification of the photograph. (2 marks)

Magnification = size of image ÷ size of real object

magnification = 45 ÷ 0.15

magnification = 300

x300

3 Dev mounts some pollen from a grass flower on a glass slide that is 76 mm long. He draws one pollen grain.

- The pollen grain in his drawing is 40 mm wide.
- The real pollen grain is 0.025 mm wide.

Calculate the magnification of his drawing. (2 marks)

The 76 mm slide length is not needed: use the drawing and the real pollen grain

Magnification = size of image ÷ size of real object

magnification = 40 ÷ 0.025

magnification = 1600

x1600

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4 A hospital lab technician photographs a red blood cell. In the photograph the cell is 30 mm across.
The real cell is 7.5 µm across.
Calculate the magnification of the photograph. (3 marks)

Same units first: 1 mm = 1000 µm

7.5 µm = 7.5 ÷ 1000 = 0.0075 mm

Magnification = size of image ÷ size of real object

magnification = 30 ÷ 0.0075

magnification = 4000

×4000

5 An electron micrograph shows a bacterium that is 18 mm long on the printed image.
The real bacterium is 3 µm long.
Calculate the magnification of the micrograph. (3 marks)

Same units first: 1 mm = 1000 µm

18 mm = 18 × 1000 = 18 000 µm

Magnification = size of image ÷ size of real object

magnification = 18 000 ÷ 3

magnification = 6000

×6000

6 A virus particle has a real diameter of 120 nm. In an electron micrograph the particle is 48 mm across.
1 mm = 1000 µm and 1 µm = 1000 nm.
Calculate the magnification of the micrograph. Give your answer in standard form. (3 marks)

Same units first: mm to µm, then µm to nm

48 mm = 48 × 1000 = 48 000 µm

48 000 µm = 48 000 × 1000 = 48 000 000 nm

Magnification = size of image ÷ size of real object

magnification = 48 000 000 ÷ 120

magnification = 400 000

4×10^5

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7 A mitochondrion is 27 mm long in an electron micrograph. The magnification of the micrograph is ×9000.

Calculate the real length of the mitochondrion in μm. (3 marks)

Magnification = size of image ÷ size of real object

9000 = 27 ÷ real size

Rearrange: real size = size of image ÷ magnification

real size = 27 ÷ 9000

real size = 0.003 mm

1 mm = 1000 μm

real size = 0.003 × 1000

3 μm

8 A chloroplast in a moss leaf cell is 5 μm long. Chen is drawing it at a magnification of ×1500.

Calculate how long the chloroplast should be in his drawing, in mm. (3 marks)

Magnification = size of image ÷ size of real object

1500 = image size ÷ 5

Rearrange: size of image = magnification × size of real object

image size = 1500 × 5

image size = 7500 μm

1 mm = 1000 μm

image size = 7500 ÷ 1000

7.5 mm

9 A ribosome appears 20 mm wide in an electron micrograph. The magnification is ×800 000.

Calculate the real width of the ribosome in mm. Give your answer in standard form. (3 marks)

Magnification = size of image ÷ size of real object

Rearrange: real size = size of image ÷ magnification

real size = 20 ÷ 800 000

real size = 0.000025 mm

Move the decimal point 5 places

2.5×10^{-5} mm

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10 A micrograph of a leaf has a scale bar labelled 20 µm. On the printed micrograph the scale bar is 40 mm long.

a. Calculate the magnification of the micrograph.

b. A guard cell on the same micrograph is 64 mm long. Calculate the real length of the guard cell in µm.

Show your working. (4 marks)

a)

The scale bar: image 40 mm, real 20 µm

Same units first: 1 mm = 1000 µm

40 mm = 40 × 1000 = 40 000 µm

Magnification = size of image ÷ size of real object

magnification = 40 000 ÷ 20

×2000

b)

64 mm = 64 × 1000 = 64 000 µm

Real size = size of image ÷ magnification

real size = 64 000 ÷ 2000

32 µm

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11 Tomasz draws a root hair cell. His drawing is 90 mm long. The real cell is 0.15 mm long.

He writes: magnification = 0.15 ÷ 90 = 0.0017

a. Calculate the correct magnification of his drawing.

b. The nucleus in his drawing is 12 mm long. Calculate the real length of the nucleus in µm.

Show your working. (4 marks)

a)

The image (the drawing) goes on top, the real cell underneath

Magnification = size of image ÷ size of real object

magnification = 90 ÷ 0.15

×600

b)

Real size = size of image ÷ magnification

real size = 12 ÷ 600

real size = 0.02 mm

1 mm = 1000 µm

real size = 0.02 × 1000

20 µm

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12 In an electron micrograph of a liver cell, a mitochondrion is 37 mm long. The magnification is ×24 000.

a. Calculate the real length of the mitochondrion in metres. Give your answer in standard form to 2 significant figures.

b. A bacterium is 3.2 μm long. Calculate how many times longer the bacterium is than the mitochondrion. Give your answer to 2 significant figures.

Show your working. (5 marks)

a)

Real size = size of image ÷ magnification

real size = 37 ÷ 24 000

real size = 0.0015416... mm

Keep the full value in the calculator

1 m = 1000 mm

real size = 0.0015416... ÷ 1000

real size = 0.0000015416... m

1.5×10^{-6} m

b)

Same units: 1 mm = 1000 μm

mitochondrion = 0.0015416... × 1000 = 1.5416... μm

times longer = 3.2 ÷ 1.5416...

times longer = 2.075...

2.1

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